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U. S. Naval Submarine Base
New London

BINOCULARS WITH TREATED SURFACES

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BINOCULARS WITH TREATED SURFACES

August 21, 1942

From: Senior Member, Night Vision Board, U.S. Submarine Base
To : Commander, U.S. Submarine Base, New London, Connecticut
Subject: Binoculars with Treated Surfaces.
Reference: (a) Your letter S24/(1220) dated June 8, 1942.
Enclosure: (1) Report on Field Test of Subject Binoculars.

1. In accordance with Reference (a) report of field test of subject binoculars is enclosed herewith.
2. No comparable untreated 6 X 30 binoculars were obtainable for comparison with the 6 X 30 treated binoculars furnished for the test.
3. Preliminary tests revealed the impossibility of making a fair estimate of the value of treating binoculars without comparison with identical untreated binoculars.
4. Request was made for treated 7 X 50 binoculars.
5. One pair of treated 7 X 50 binoculars were received 15, August, 1942.
6. The tests were completed on the first clear night, Tuesday, 18 August, 1942.
7. Wm. S. Verplanck, Ph.D., of N.D.R.C. and Neil R. Bartlett, Ph.D., N.D.R.C., both from the Night Vision Laboratory, collaborated in this project.

C. W. SHILLING

ENCLOSURE I

REPORT ON BINOCULARS WITH TREATED SURFACES:

Two pairs of Bausch and Lomb 7-power, 50-millimeter binoculars were compared in a field try-out. One of these pairs of binoculars had been treated so that its transmission of light, as determined by physical measurements, was greater by 32% than that of the other. In all other respects these binoculars were identical. A difference in transmission of this order is minor with respect to the fluctuations in sensitivity of the human eye.

These tests were held on a clear night on the golf course of the Officers' Club of the U.S. Submarine Base, New London, Connecticut. There was a half moon which, as the tests went on, was setting. The night was fairly dark; but, unfortunately, it was not possible to make absolute measurements of the prevailing illumination.

Ten subjects were employed in the tests, four from the U.S.S. Mackerel were experienced night lookouts, and the other six were seamen awaiting assignment in the Submarine School. These subjects were previously tested for visual acuity, pupillary distance, corneal astigmatism, and night vision, and found to closely approximate normal.

Twelve targets, each of which showed black parallel lines upon a white background, were placed along the golf course at distances ranging from 120 to 700 feet from the observers posts. It was possible to vary the position of these targets so that the lines were either horizontal or vertical. In the tests, two men were run together, one

REPORT ON BINOCULARS WITH TREATED SURFACES (Cont'd)

using the treated binoculars, and the other the untreated. The task of the observer was to call off the orientation of the lines of each target, and the distance of the farthest target correctly identified was taken as a measurement of performance. Each observer used each pair of glasses five times, making a total of ten judgments per man. Both positions of the lines and the order of use of each pair of binoculars were varied by a predetermined randomization.

The variability in scores made it extremely difficult to demonstrate significant differences statistically.

When conversion has been made to the minimal visual angle separable in minutes, the average visual angle just discriminated with the treated glasses was 16.1 minutes, with the untreated glasses, 17.5 minutes. This difference, although in the right direction, is not significant.

When the scores of each man are considered separately we find that in 31 pairs of judgments there was no difference in the distance the observer was able to see with either glass. Sixteen times the treated glasses enabled him to see further, and three times the untreated glasses seemed to give an advantage. By chance alone, if there were no difference between the glasses, instead of the above proportion of 31, 16, 3, one might expect the proportion 25, 12.5, 12.5. The difference between this proportion and that actually found indicates that the treated glasses are reliably better. The probability that such a proportion as was found would occur by chance is 1 in 100.

REPORT ON BINOCULARS WITH TREATED SURFACES (Cont'd)

From these results it may be concluded that the predicated superiority of the treated glasses for night use is actually present, but that owing to the variability of the human eye the difference is not so clear-cut as one might wish. As the enclosed graphs indicate, at all distances, the treated glasses permitted the accurate calling of the direction of the lines more frequently than did the untreated.

If one disregards such factors as contrast, illumination, curvature of the earth, and perception, and if conditions exist exactly comparable to those of this experiment, the differences found would indicate that with the treated binoculars a white object 300 feet in length could be seen at approximately 73,000 feet, while with the untreated binoculars, it could be seen only at 64,000 feet. This is an improvement of about 1 in 7.

It must be remembered in considering these results that only one specimen of each of the binoculars was used. Other binoculars, it must be confessed, might yield other results.

If more complete information on the details of the structure and results of this field test are desired, they may be obtained by application to the Night Vision Laboratory at the Submarine Base, New London, Connecticut.

Graph:
Percentage of correct identification of target as function of distance.

